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## ORIGINAL ARTICLE

# Role of 1.5 T MRI in evaluation of degree of placenta previa

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### ABSTRACT

**Objective:**The role of MRI in assessment of placenta previa.

**Subjects and methods:**Ultrasound, color Doppler and magnetic resonance imaging were performed for 60 gravid females with placenta previa prior to delivery. Delivery plan was made according to the imaging prediction of the degree of placenta previa and the presence or absence of placenta accreta. Findings at cesarean section considered the gold standard of reference.

**Results:**Matching between US and MRI findings was 73.3% (n= 11/15) of the negative cases and in 80% (n = 36/45) of the positive cases of placenta accrete.

Sensitivity, specificity, positive predictive value and negative predictive value of Ultrasound and MRI were 80%, 73.3%, 90% , 55% and 88.9, 86.7, 95.2%, 72.2% , respectively,The accuracy of US and MRI was 78.3 % and 88.3%respectively regarding their ability to predict placenta accreta.

**Conclusion:**Magnetic resonance imaging should be added to the ultra sound examination for accurate diagnosis of placenta previa and the co-existing placenta accreta.

**Keywords:**Magnetic resonance imaging; Placenta accreta

## 1. INTRODUCTION

Placenta previa is defined as lower uterine segment abnormal implantation of the placenta overlying or near the internal cervical os, and is diagnosed after 15 weeks of gestation (1).

Risk factors of placenta previa include: advanced maternal age, number of previous CS. Patients with placenta previa have 12 times the usual risk of having a recurrent previa in subsequent pregnancies (2).

### Grades of placenta previa :

Grade I: placenta is implanted in the lower segment but its edge does not reach the internal os.

Grade II: lower placental edges reach the os but do not cover it.

Grade III: edge covers the os and the placenta is asymmetrical.

Grade IV (central placenta previa): placenta symmetrically covers the os (2).

Placenta accreta (PA) occurs when a defect of the decidua basalis allows the invasion of chorionic villi into the myometrium. PA is classified according to the depth of myometrial invasion into placenta accreta vera (Fig. 1) where the villi are attached to the myometrium without muscular invasion, placenta increta where the villi partially invade the myometrium, and placenta percreta that's considered the most serious type as the villi are

not penetrating the whole myometrial thickness but also may extend beyond the serosa (Fig. 2,3) (3).

Undiagnosed placenta accreta is associated with high rates of maternal morbidity and mortality due to intrapartum hemorrhage, uterine rupture, bladder and rectum invasion (4)

Prenatal diagnosis of placenta accreta has historically been difficult, and the accuracy of sonography compared with magnetic resonance imaging (MRI) remains in question.

Our study aimed to detect the role of MR imaging in the evaluation of cases at high risk of placenta accreta.

## 2. The patients and methods

From December 2018 to June 2019 series of 60 gravid females with age range between 20 and 39 years (mean  $29.4 \pm 9$  SD) underwent Pelvic ultrasound, Color Doppler US and Pelvic MRI. The study was approved by our institution's ethics committee Faculty of Medicine, Zagazig University and a written informed consent was obtained from all participants. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

All patients gave their informed consent before inclusion in the study.

The inclusion criteria were all pregnant females who have high risk of abnormal placental location and/or implantation including advanced age, more than 3 previous CS. and past history of placenta previa . we examined all these females and exclude those who had normal placental site.

We did Trans-Abdominal Pelvic Ultrasound by B-mode first using a 3-5 MHz sector-array transducer on a LOGIQ 7 PRO, GE (General electric medical system) where the patient lying in a supine position. The scanning protocol in our study includes scanning of the placenta in both transverse and longitudinal planes to select the patients with abnormal placental site then we did CCDI (Color-coded Doppler imaging) and PDI (Power Doppler imaging).

Our 2nd step was MRI that was performed using a 1.5 T Gyro scan Intera, Philips medical systems, Netherland), with the patient lying in a supine position using phased array pelvic coil.

MR PROTOCOL:

- T2 weighted pulse sequence fast spin echo (FSE): TE 90 ms, TR 3.1 s in the axial, sagittal and coronal planes.
- T1weighted sequence spin echo (SE): TE 10 ms, TR 422 ms in the axial, sagittal and coronal planes.
- T2 Single Shot spin echo (SSH-SE): TE 309 ms, TR 15.0 s in the sagittal plane.

For all the mentioned sequences slice thickness = 5-6.5 mm with 1 mm gap, flip angle=90 and FOV=370-400 mm. Balanced fast field echo (B-FFE): TE 1 ms, TR 3 ms in the sagittal and coronal planes using matrix 384 x192.

Sequences (1) and (2) were performed with respiratory triggering to control maternal and fetal motion artifacts. Total scanning time is 32min. No intravenous injection on of gadolinium was used. Accuracy was represented using the terms sensitivity, specificity, +ve predictive value, -ve predictive value, and overall accuracy.

## 3. STATISTICAL ANALYSIS

The findings of US and MR imaging studies were evaluated and expressed as mean  $\pm$  standard deviation and proportions were expressed as percentages. Sensitivity, specificity and diagnostic accuracy were calculated. All data manipulation and analysis were performed using the 20<sup>th</sup> version of SPSS (Statistical Package for Social Sciences).

## 4. RESULTS

The current study included 60 cases of placental abnormal location and/or implantation. Age  $29.4 \pm 9.3$  ,GA (weeks)  $33.4 \pm 3.7$  ,Parity median range 2 ,The patients suffered from vaginal bleeding were 60 (100%) ,pain 10 (16.7%) stiffness at PV/PR examination , micturition or defecation disturbance 7 (11.7%) History of prior CS was elicited in 58/60 cases (96.7%).

Among the 60 cases, placenta previa was found to be central in 35/60 cases(58.33%), complete in 20/60 cases (33.33%), marginalis in 3/60 cases (5%) & low lying in 2/60 cases (3.33%)  
The final diagnosis was reached in 45 patients clinically at delivery and by pathologic examination.

Among the 45 cases proved to have placental invasion 21/45 had placenta accrete (46.7%),18/45 had placenta percreta (40%) & 6/45 had placenta Increta (13.3%). Cases diagnosed as placenta previa with no myometrial invasion were 15 cases (25%)

US has suggested the diagnosis of placenta previa with accreta in 40/60 patients (66.7%) and placenta previa without accreta in 20/60 cases(33.3%)

According to the operative findings and/or pathology reports, 36/40 patients were true positive(90%) and 4/40 were false positive(10%)

In our Study, the MRI features of patients proved to be accreta where heterogeneous placental signal intensity was found in 40/45 cases (88.9%), dark intraplacental bands in 36/45 cases (80%), focal interruption in the myometrial wall in 34/45 cases (75.5%), uterine bulging 24/45 cases (53.3%) & direct visualization of invasion of pelvic structures in 14/45 cases (31.1%) (Table 1).

Matching between Doppler US and MRI findings took place in 73.3% (n=11/15) of the negative cases and in 80% (n=36/45) of the positive cases of placenta accreta in our work (table 2). MRI and US had matched diagnosis regard less the outcome in 78% (n=47/60) and mismatching in 22%.

Ultrasound and MRI were 80%, 73.3%, 90% , 55% and 88.9, 86.7, 95.2%, 72.2% , respectively,The accuracy of US and MRI was 78.3 % and 88.3%respectively regarding their ability to predict placenta accrete (table 3).

Table 1 ;Shows the sensitivity, specificity, PPV and NPV of MRI features of the placenta.

	Sensitivity	Specificity	PPV	NPV	Accuracy
<b>Heterogeneous placental intensity</b>	88.9	86.7	95.2	72.2	88.3
<b>Dark intra-placental bands on T2</b>	80	93.3	97.2	60.9	83.3
<b>Focal interruption in myometrial wall</b>	75.5	93.3	97.1	56	80
<b>Direct visualization of invasion of pelvic structures</b>	31.1	100	100	32.6	48.3

Table 2; Shows the degree of agreement between US and MRI regarding the abnormal placental implantation:

	% agreement at + cases	% agreement at - cases	Kappa	p
<b>Abnormal placental location and/or implantation</b>	11(73.3%)	36(80.0%)	.65	.02

Table ;3 Shows the sensitivity, specificity, PPV, and NPV of sonography and MRI for their ability to predict Placental invasion in our current study.

	Sensitivity	Specificity	PPV	NPV	Accuracy
<b>Final US</b>	80	73.3	90	55	78.3
<b>Final MRI</b>	88.9	86.7	95.2	72.2	88.3

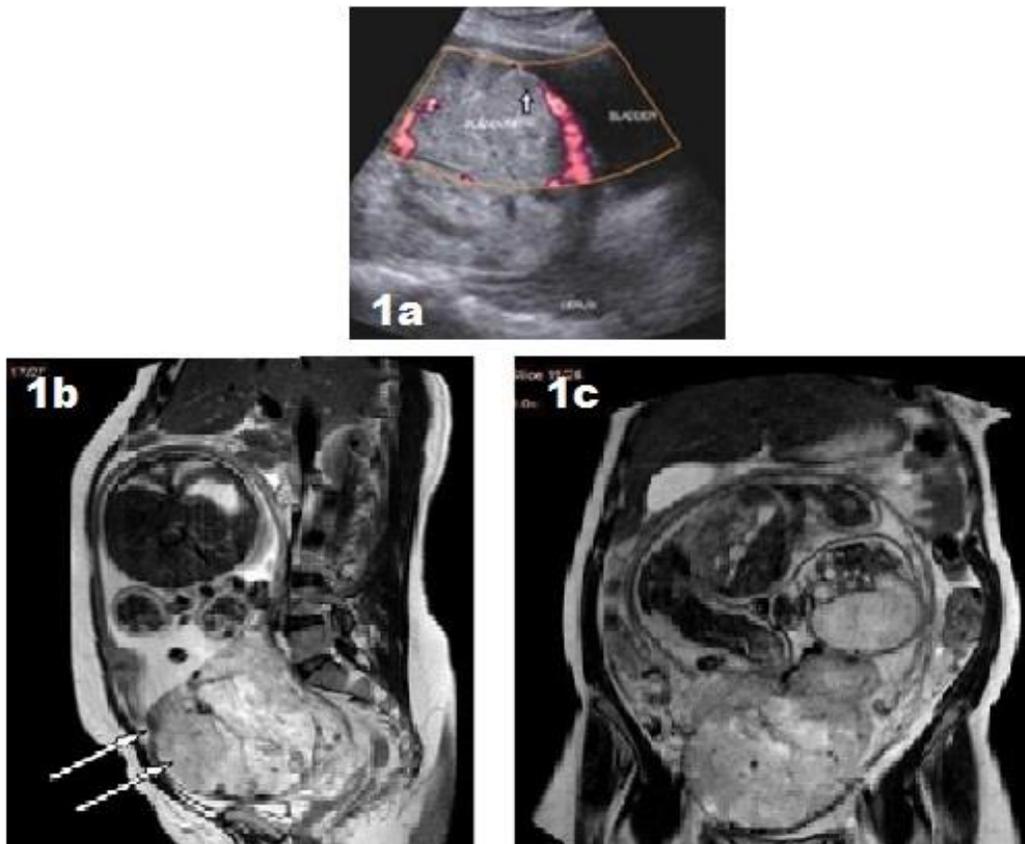


Fig. 1: placenta accrete

33 yo pregnant female, GA 35 w. gives history of previous 2 CS (1a) Doppler U/S and T2 WI MRI in (1b) sagittal & (1c) coronal views showed placenta previa complete centralis with thinned out myometrium and lost clear retro-placental space as well as interrupted retro-placental vascular bed denoting placenta accreta.

MRI images show bulging of the lower uterine segment, thickened in-homogenous placenta infiltrating the inner layer of the myometrium at the lower uterine segment (arrows).

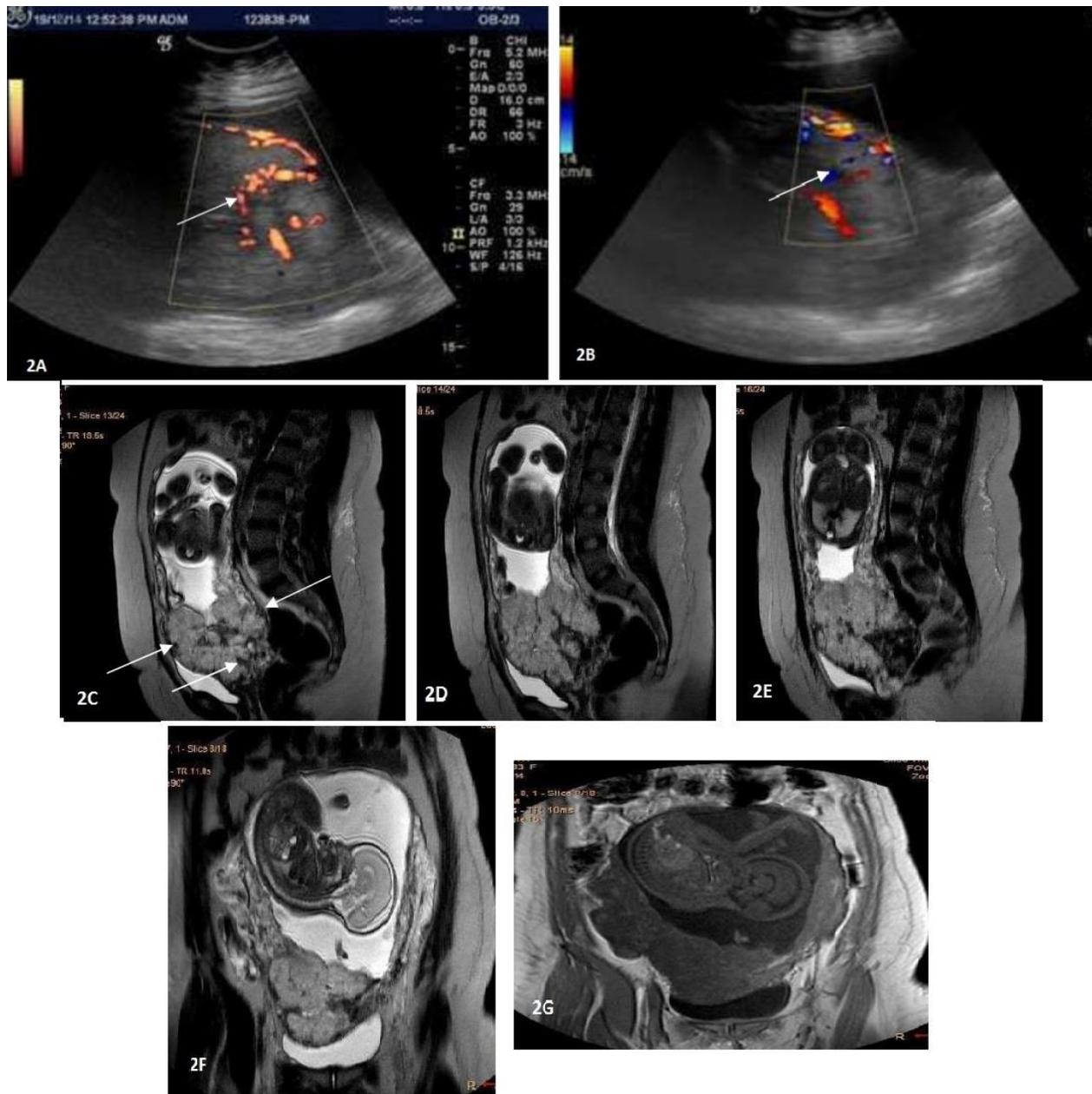


Fig. 2: Placenta percreta

31 y pregnant Female, GA 31 w. gives history of previous 3 CS. Color Doppler U/S (a,b) show placenta previa complete centralis, loss of clear retro-placental space with gap in the detected retro-placental blood flow suggesting placenta accrete (arrows).

MRI in Sagittal T2 WI (c,d,e) and Coronal T2 WI (f) and Coronal T1 FSE WI (g) show bulged lower uterine segment, thickened in-homogenous placenta infiltrating and interrupting the anterior and posterior parts of the lower uterine segment with infiltration of the cervix (arrows at 2C), presence of placental lacunae. MRI picture is keeping with placenta percreta.

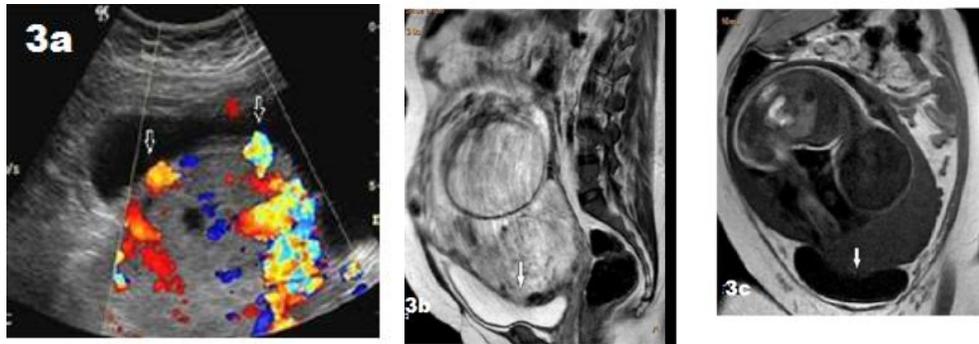


Fig 3: Placenta percreta

32 y pregnant Female, GA 34 w. gives history of previous 2 CS

Doppler US (a) show placenta previa complete centralis heterogeneous placenta extending to the serosal surface of the bladder without any intervening the myometrium, irregular bladder wall with increased the vascularity on the interface with crossing vessels to the bladder (arrows)

MRI Sagittal T2 WI (b) and Coronal T1 FSE WI (c) show placenta previa complete centralis, thickened heterogeneous placenta with markedly thinned and interrupted myometrium. Lower uterine bulge with irregular outline with no intervening fat planes between the placenta and the bladder.

### 5. DISCUSSION

Placenta accreta (PA) is a cause of maternal morbidity and mortality due to postpartum hysterectomy. (5), so early diagnosis of placenta accreta is life saving. The primary evaluation of the placenta should be done by trans abdominal and transvaginal sonography followed by pelvic MRI in cases were US were inconclusive (6)

The current research was a prospective study to determine the need for MR imaging in diagnosis of cases with placental abnormalities and invasion. Sensitivity and specificity of US were 68 % and 78.57 % while MRI were 80 % and 85.71 % respectively in their ability to diagnose placental invasion

In 2011, Mansour and Elkhayat, WM have concluded that sensitivity and specificity of Doppler US was 86.6% and 80% while MRI was 93.3% and 85% in their ability to diagnose placenta accreta (7)

The sensitivity of the US and Color Doppler sonography is relatively lower in our study which may be due to the number of false negative cases (5/60 in MRI and 9/60 in US), may be due to the fact that on US basis they had made use of trans-labial instead of the trans-vaginal approach. The abdominal transducer is affected by obesity which is commonly associated with pregnancy and the

degree of bladder filling ,cases presented in the study were at the third trimester where urinary urgency is a common association.

According to the literature, visualization and number of lacunae has the highest sensitivity in the diagnosis of PA, allowing identification in 78%–93% of cases after 15 weeks gestation, with a specificity of 78.6% (8)

In 2008, Usta IM et.al reported that presence of lacunae in the placenta was the most predictive sonographic sign of PAD with sensitivity 79% and a PPV of 92%. (9)

In our study, obliteration of the retro-placental clear space was found to have the highest sensitivity (80%), followed by vascular lacunae (66.7%) , decreased myometrial thickness(57.8%) and interruption of the posterior bladder wall-uterine interface along with increased vascularity on uterine interface between uterine serosa and bladder wall (31.1%)

Another study took place in 2007 by Lax A, et.al who have described the MRI diagnostic features of abnormal placental implantation as irregular thick low T2 SI intra-placental bands, markedly heterogeneous placenta, and bulging of the lower uterine segment. Lax et al saw that the abnormal low T2 SI bands were the result of fibrin deposition (10). In concordance with these findings, we also found that the abnormal

heterogeneous signal intensity of the placenta was seen in 88.9% low T2 SI intra placenta bands was seen in 80% and bulging of the lower uterine segment was seen in 53.3% of the surgically/pathologically proved cases of placenta accreta.

Regarding the MRI technique in our study, we relied upon spinecho sequences in assessing placental invasion to the myometrium or beyond as follows:

(1) T2- weighted images to detect the intermediate signal intensity placental bulk and distinguish it from the inner and outer myometrial dark layers as well as from the Myometrium itself which is seen more intermediate SI.(2) T1-weighted images showed distended tortuous placental/ myometrial vessels as clustered bright signal intensities (probably due to blood stagnation especially in the pelvic and lower limb vessels accompanying pregnancy). The interface between the urinary bladder and the Myometrium was also more clarified at that sequence. T2-weighted images may display overestimation of percreta, in such a case we had to check for disruption of the fat plane overlying the uterine serosa in T1-weighted sequence.

The limitation in using spin echo sequences with respiratory triggering is a lengthy examining time provided that the FOV is wide (to occupy as much as possible of the gravid uterus in the field) with large number of slices.

MRI was more superior than Doppler US in the evaluation of posteriorly located placenta as MRI showed the disruption in the myometrium posteriorly with increased signal void vessels around the uterus.

Even if ultrasound and MRI results do not match, we decided the more aggressive findings as false positive results are less harmful to the patient than false negative ones in agreement with Usta IM, et.al (9). Placenta previa-accreta is associated with higher maternal morbidity, but similar neonatal outcome compared with patients with an isolated placenta previa inconcordance with Lax A, et.al (10).

## 6. CONCLUSION

However US remains the first modality for evaluation of the placenta, but using pelvic MRI as a complementary study is essential for more accurate evaluation of the depth of myometrial invasion specially in posteriorly located, the presence of parametrial invasion in cases of placental adherence that may results in modifications of surgical treatment.

### Conflict of interest

The authors of this manuscript declare no relevant conflicts of interest, and no relationships with any companies, whose products or services may be related to the subject matter of the article.

### Funding

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### Ethical approval

Institutional review boards' approval were obtained.

### Informed consent

Written informed consent was obtained from all patients.

### Statistics and biometry

The corresponding author has great statistical expertise

### Methodology

- Prospective.
- Diagnostic study.
- Performed at single center.

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## 7. RECOMENDATATIONS

To do MRI as a complementary study to US for all patients who are in risk of placenta previs.

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